

BRAIN ABSCESS*

By GILBERT HORRAX, BOSTON

FORTY-TWO years have elapsed since Sir William Macewen¹ wrote as follows in the preface to his classical book upon *Pyogenic and Infective Disease of the Brain and Spinal Cord*: "Ten years ago a physician reported in *The Lancet* a case of an abscess of the brain discovered at post-mortem in one of the London hospitals and quoted the remark of an eminent surgeon who saw it, that an abscess of the brain was one of those cases which occurred but once in the course of a lifetime. An individual experience of the last ten years given in this volume and supported by numerous cases recorded by other surgeons, affords quite a different estimate. . . . Though not sharing the hopelessness of the opinion expressed in 1883 by a distinguished neurologist as to the inutility of operations on the brain undertaken for abscess, the author was then inclined to take a more sombre view of the prospects of recovery from such operations than his subsequent experience has proven to be necessary. *He now regards an uncomplicated cerebral abscess, early recognized, accurately localized and promptly operated on* as one of the most satisfactory of all intracranial lesions, the patient being at once relieved from a perilous condition and usually restored to sound health."

With this statement before us, it is interesting to note the general methods which Macewen employed in the treatment of brain abscesses, and the success with which they were attended. His usual technique was first to gain as much information as possible as to the exact location of the abscess, particularly as to where it most nearly approached the surface of the brain and skull. Next he made a rather large bony opening over the site of the abscess, after which the cavity was opened widely and thoroughly washed with a mild antiseptic solution. Finally he placed within the cavity, in order to give it free drainage, a decalcified chicken bone. A dressing was then applied *and left in place*, usually for several weeks. When the dressing was removed the wound was often completely healed.

Using this technique, Macewen reported the results in a series of 26 abscesses situated within the brain substance. Two of the fatal cases (both cerebellar) were not operated upon by Macewen himself, but were presumably under the care of an assistant trained in his methods. Among the total 26 cases, irrespective of whether they were or were not operated upon, there were 8 deaths, a mortality of 30.7 per cent. If we take only the 24 patients under Macewen's personal care, there were 6 deaths, or a mortality of 25 per cent. Of these, however, only 20 were operated upon, with 2 deaths, giving an operative mortality of 10 per cent.

Since Macewen's day, no one, so far as I can ascertain, has been able to duplicate his highly successful treatment of brain abscesses in a large series of cases. There are, perhaps, many reasons to account for this, but by studying in detail the case reports which he gives, three factors seem to play the most

* Amplification of a paper given at the joint meeting of the British and American Societies of Neurological Surgery, London, July, 1935.

On examination she was pale, somewhat wasted, and ill-looking. A swelling was palpable in her abdomen to the right of the umbilicus—cylindrical, tender, and movable. The blood examination showed 17,000 white cells, with 75 per cent polymorphs; no abnormality was found in the faeces (Dr. F. H. Teale). An X-ray examination by barium meal showed no abnormality.

A tentative diagnosis of regional ileitis was made, and confirmed at operation (L. E. B.-W.). The omentum was adherent to the mass by recent adhesion; a coil of ileum, eight inches in length, ending at approximately 2 in. from the ileocaecal valve, showed the typical appearances of Crohn's disease. The proximal intestine was dilated and contained a Meckel's diverticulum, adherent by its tip to the mesentery. As seen in *Fig. 380*, this, too, was involved in the pathological process. The affected part was removed, the cut ends of the ileum were closed, and a lateral anastomosis was performed between the proximal bowel and the caecum. The patient made a good recovery and was discharged three weeks after operation. Up to date she has remained well, and at six weeks had gained one stone in weight.

The histological appearances found are shown in *Figs. 378, 381*.

SUMMARY

1. Some of the literature relating to Crohn's disease is reviewed.
2. The aetiology, clinical and pathological features, radiological diagnosis, and treatment are discussed.
3. Two cases are reported and illustrated.

We are indebted to Dr. L. W. Proger, of the Royal College of Surgeons, for his kind help with the pathological investigations.

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Gradually, during the past ten years especially, neurosurgeons and otologists have re-emphasized many of these principles as more concentrated thought has been directed toward the subject. Thus Eagleton² has written extensively on the pathways by which infection extends from the otitic process into the brain, and McKenzie³ has called attention to the importance of opening the abscess at its nearest approach to the surface. Grant⁴ demonstrated the great advantage in holding off operation, if possible, until capsulation had taken place, while Cahill⁵ and King⁶ particularly have stressed repeatedly the favourable results of wide open drainage. For this purpose Cahill and recently Kaplan⁷ have advocated the use of the Mosher wire drain, but it is probably the general principle rather than the particular form of drain which is most important. To my mind the method of treatment described by King is ideal in cases to which it is applicable. It is similar in its essential aspects to the technique called "marsupialization" by Cushing and used by him for many years. This technique I described briefly in 1934,⁸ and it will be referred to subsequently. In a recent paper Adson and Craig⁹ have likewise advocated a somewhat similar method, using two catheters and gauze packing in order to hold the cavity widely open and thus to prevent 'pocketing'. In 1934 Cairns¹⁰ discussed various aspects of the treatment of brain abscesses, showing that no single method could be utilized in all cases. He wisely emphasized the importance not only of applying correctly whatever method seemed indicated, but of giving the patient the advantage of extremely careful after-treatment. In contrast to these methods of opening the abscess widely, occasional successes have been obtained by single or repeated tapplings of a brain abscess, as described by Dandy.¹¹ This procedure undoubtedly has its place in the treatment of deep-seated abscesses or those which contain sterile pus. It is likewise helpful in unencapsulated abscesses as a means of lowering intracranial pressure in the hope that the abscess may become encapsulated, after which it can be dealt with in the more usual way. This, likewise, was a principle taught and used by Dr. Cushing, but in my opinion it should never replace marsupialization or similar open methods in superficial encapsulated abscesses. A third procedure sometimes used for the eradication of a brain abscess is total extirpation. Operations of this type have met with success at times, as in three instances here recorded, but there are obvious drawbacks and dangers to such an undertaking.

Irrespective of the surgical methods employed, however, it must be admitted that the present mortality reports for brain abscesses are discouragingly high, ranging from 22 per cent up to 56 per cent. This very considerable discrepancy can doubtless be explained not only by the types of procedure used for drainage, but more readily perhaps by the fact that in some papers (those with the lower

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The purpose of this paper is to review a series of 30 cases seen during the years 1926 to 1935,* with special reference to their grouping and remarks concerning the methods of treatment. All of these patients had true intracerebral or intracerebellar abscesses. Any instances of extradural or subdural collections of pus sometimes included in the general term of 'brain abscess' have been eliminated. In order that a clear idea may be had of the type of brain abscess under discussion, and thus, if profitable, to compare the methods of treatment here advocated with those, for instance, which were alluded to in Macewen's series, we must separate the 30 cases of our own into two entirely distinct groups.

**Group I.—ACUTE AND MULTIPLE (OFTEN METASTATIC)
ABSCESSSES USUALLY HAVING SERIOUS PULMONARY
OR SYSTEMIC COMPLICATIONS**

The first group may be dismissed briefly, because, in reviewing the case histories, it is extremely doubtful whether any of them should have been regarded as surgical problems and subjected to an intracranial operation, even of a palliative variety. Such procedures as were carried out were for the most part simple tappings, done with the vain hope that if intracranial pressure was relieved the patient might be able to overcome the accompanying serious systemic condition. In no instance was this hope fulfilled.

Of the patients 12 came within this category, and of this number 10 were operated upon. Six patients had metastatic abscesses with complications such as bronchiectasis, lung abscess, empyema, etc. The other 6 had local complications in the form of meningitis or spreading encephalitis or the abscess had already ruptured into the ventricle.

No case in *Group I* survived either with or without operation, and it is my impression that little can ever be expected in the treatment of such seriously complicated conditions, except perhaps in an extremely occasional instance.

CASE REPORTS

One or two brief case histories will suffice to illustrate the conditions obtaining in this group.

Case 1.—B. M. G. (P.B.B.H. Surgical No. 36455), a 12-year-old girl, was referred by Dr. S. S. Martin, of Windsor, Vt., on May 12, 1930.

HISTORY.—She had had an empyema of the right chest drained seven weeks previously. Four weeks later she began having headaches and vomiting, and rapidly developed a left

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Comment.—There is little to say about such a case except to repeat that any form of intracranial operation under similar systemic conditions seems almost unwarranted. On the other hand, when confronted with the decision clinically, it is difficult to refuse at least some such simple attempt to save a life.

The following record illustrates the second type of these hopeless cases, although in many of this variety it may not at first be possible to diagnose multiple lesions.

Case 2.—J. R. W. (P.B.B.H. Surgical No. 26599), a 40-year-old white male, was referred by Dr. A. R. Gardner, of Lowell, Mass., on June 16, 1926.

HISTORY.—The patient had had pleurisy followed by empyema in February, 1926, and this was complicated by osteomyelitis of the left femur three weeks before admission. Frontal headache and paralysis of the left arm and leg had developed six days prior to entrance, and he had had one convulsion three days previously. Neurological examination showed early choked disks with $\frac{1}{2}$ D elevation, and the left pupil was larger than the right. He had a left partial hemiplegia, paralysis being complete in the left arm. His deep reflexes were greater on the left than on the right, with a positive Babinski on the left. There was likewise a hemihypæsthesia of the left side.

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Comment.—It could not be told from this patient's examination that multiple abscesses were present; therefore, the operative procedures seem quite warranted. Certainly no more radical measures than repeated tappings could have been considered with an abscess at so great a depth below the surface.

Group II.—CHRONIC SINGLE ABSCESSSES (USUALLY ENCAPSULATED)

The second group is the one with which we are particularly concerned, as it represents the cases which are distinctly amenable to surgical therapy. The types of treatment are to be discussed, not only as to their technical features, but in connection with the clinical application or indication for one method or another, and a brief word as to the aetiology of the abscesses in this second group would appear to be of value.

BRITISH JOUR. OF SURG.

538
X X V 1938 JAN. PAGE

Into this group fall the remaining 18 patients, and it is abscesses of this type which form the bulk of those in reported series, including that of Macewen. All of our patients in this class were operated upon, and all survivors have been followed from approximately one to six years, the majority from two years upward, so that there is little chance of any having a latent process which might again become active.

Aetiology.—Two possible comments might be made concerning the sources of infection from which the brain abscesses in this group are derived. In the first place, the variety of antecedent infection was doubtless greater than that usually seen by otolaryngologists, although middle-ear complications were the largest single factor. In the second place, osteomyelitis of the skull or frontal sinusitis accompanied by osteomyelitis accounted for one-third of the total number of abscesses.

The following is a list of the aetiological factors :—

| | | | |
|------------------------------|----|----|----|
| Otitis media and mastoiditis | .. | .. | 4 |
| Osteomyelitis of skull | .. | .. | 3 |
| Frontal sinusitis | .. | .. | 3 |
| Dental abscess | .. | .. | 2 |
| Scalp abscess | .. | .. | 2 |
| Nasal furuncle | .. | .. | 1 |
| Tonsillar infection | .. | .. | 1 |
| Upper respiratory infection | .. | .. | 1 |
| Unknown | .. | .. | 1 |
| Total | | | 18 |

Mortality.—The total operative mortality in *Group II* was 16·6 per cent, as there were 3 deaths among the 18 patients during their stay in the hospital, which averaged about 8 to 10 weeks. Of those who died, two succumbed to meningitis following a spreading osteomyelitis of the skull. In the other the abscess was never found, a cerebral tap reaching the ventricle when the patient was *in extremis*. Thus, there were in reality but 2 deaths in 17 cases in which the abscess was treated, making the mortality 11·7 per cent. One patient died five months after leaving the hospital from a cause unrelated to his abscess.

Five of the fourteen survivors have certain disabilities, as follows : Two have developed convulsions. One of these and two others have weakness of one arm and leg. The fifth patient has visual acuity reduced to reading large print, but gets along very well in school.

METHODS OF TREATMENT

It will be seen from the accompanying table (*Table I*) that, although a number of different procedures are listed, only three of these need be considered seriously—

Table I.—CHRONIC ENCAPSULATED BRAIN ABSCESS : SUMMARY OF METHODS OF TREATMENT AND END-RESULTS

| METHOD | NO. OF CASES | LIVED | DIED |
|-------------------------------------|--------------|-------|------|
| Marsupialization | 9 | 8 | 1 |
| Tapping | 4 | 4 | 0 |
| Extirpation with drainage .. | 3 | 3 | 0 |
| Drainage only | 1 | 0 | 1 |
| Cerebral tap (abscess not found) .. | 1 | 0 | 1 |
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namely, marsupialization, tapping, and extirpation of the abscess *en bloc*. The case in which no abscess was found by an attempted tap is included only for the sake of completeness, and the patient whose abscess was drained merely by the insertion of a gutta-percha wick had complicating circumstances which prevented any more radical attack upon the lesion.

Marsupialization.—One-half of the patients were treated by this method, with one death—a mortality of 11.1 per cent. Because of the highly satisfactory results by this procedure, it is my strong feeling that whenever one is dealing with a well-encapsulated abscess within 1 to 3 cm. of the surface of the cortex, marsupialization should be the treatment of choice. A brief description of its technical steps may be given.

TECHNIQUE.—An opening (roughly circular) about 3.5×3.5 cm. in two diameters is made in the skull as nearly as possible directly over the area where the abscess is closest to the surface. This may be determined in some instances by one or more small burr holes over the suspected area and then gently inserting a blunt ventricular needle until abscess wall is felt, as described by McKenzie (*Fig. 382*). In other instances the site of the abscess may be shown with exactness

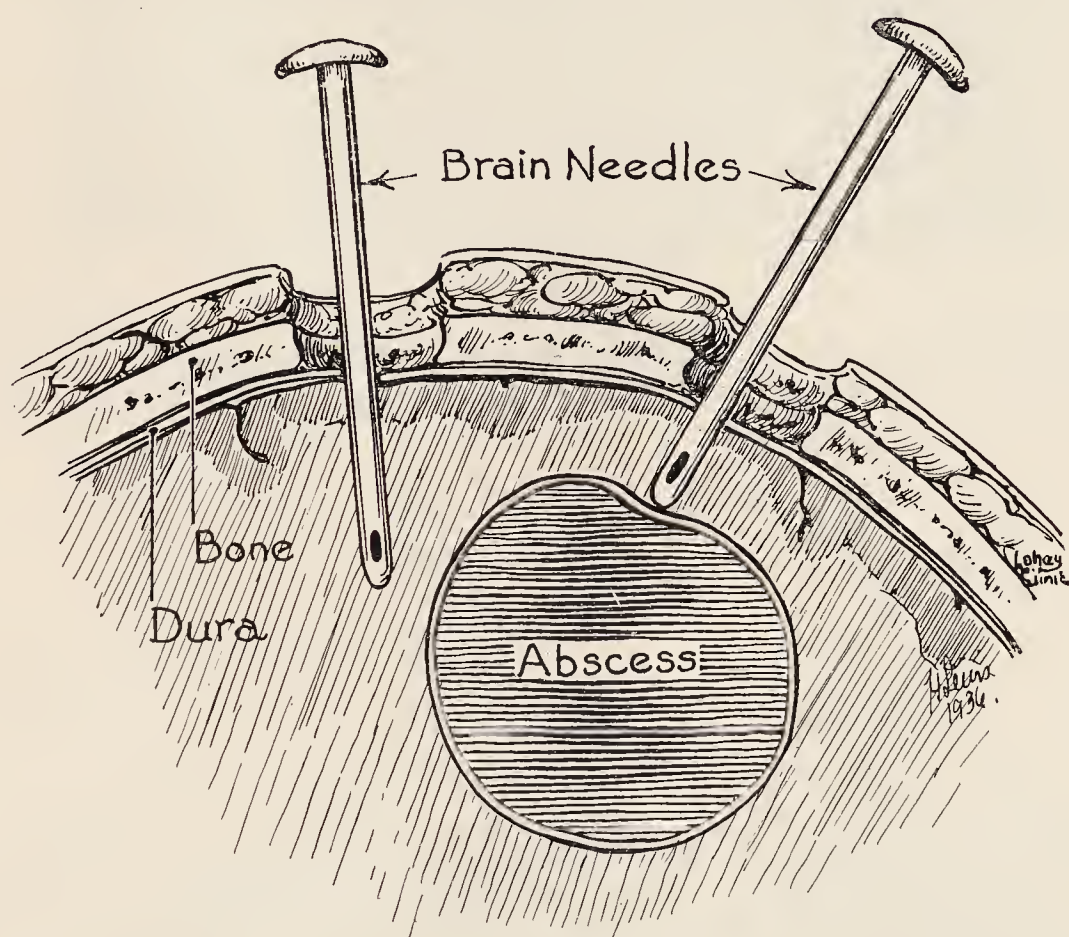


FIG. 382.—Localization of a brain abscess by means of tapping over the suspected area. (After McKenzie.) Drainage would be instituted where it was shown that the abscess came nearest the surface.

by ventriculography (*Fig. 383*). The dura is next opened by radiating incisions to the limits of the bony opening. Cortex, as a rule, will bulge markedly through this opening, and should be removed quickly down to the abscess capsule by electro-surgical methods (*Fig. 384*). Capsule will now tend to bulge upward into the uncapped area and will often approach the surface, even though it may at first have been considerably below the cortex.

The next manoeuvre is to empty the abscess partially so that tension may be reduced and consequently, when capsule is later opened widely, there will be no



FIG. 383.—Localization of a brain abscess by ventriculography. Arrow 2 points to the blunted and pushed-back anterior horn of the left ventricle due to a left frontal lobe abscess. Arrow 1 indicates normal right ventricle. (*Surgical Clinics of North America.*)

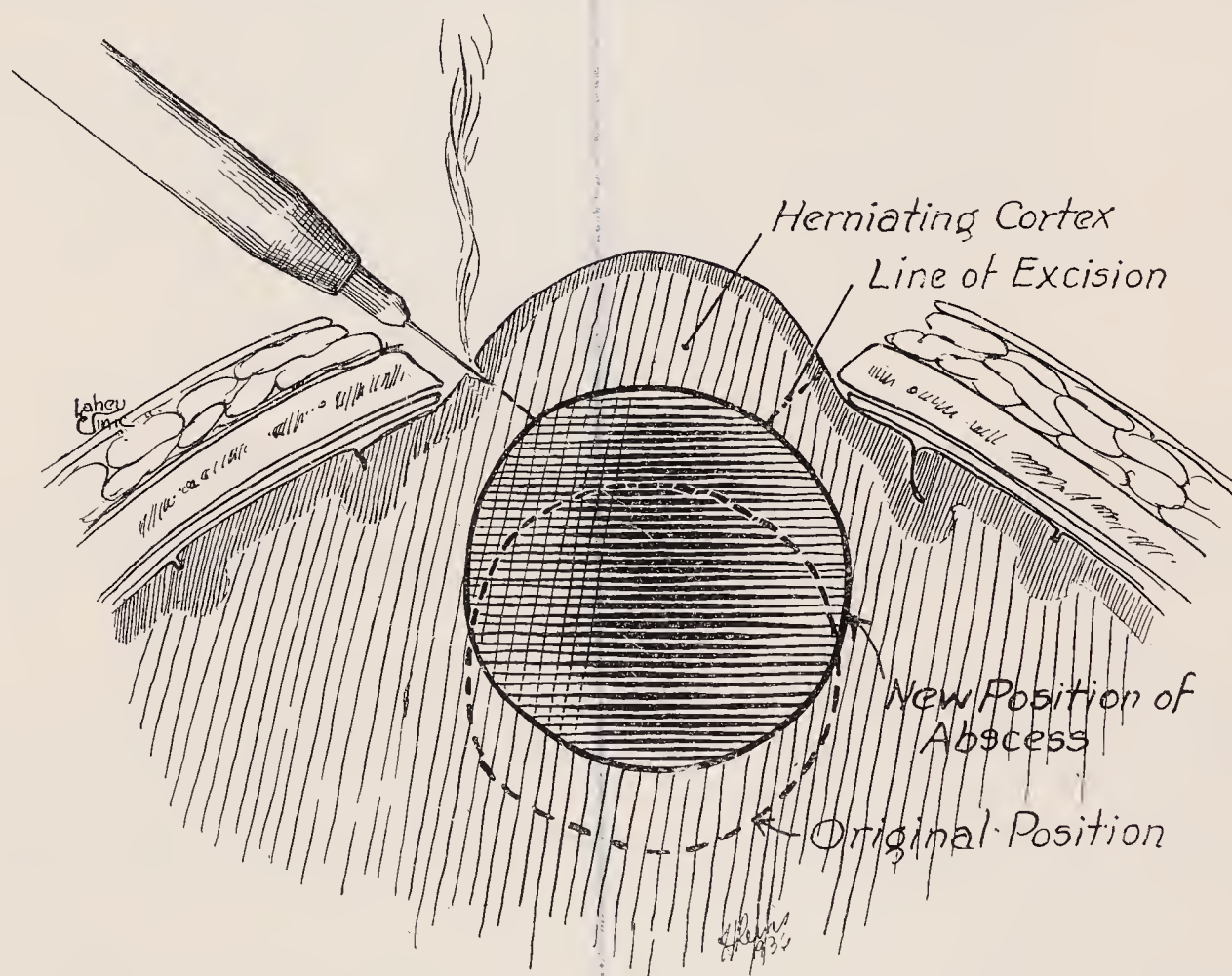


FIG. 384.—Electrosurgical excision of the cortex over an abscess, showing how the abscess itself becomes pushed upward toward the surface with the herniating cortex.



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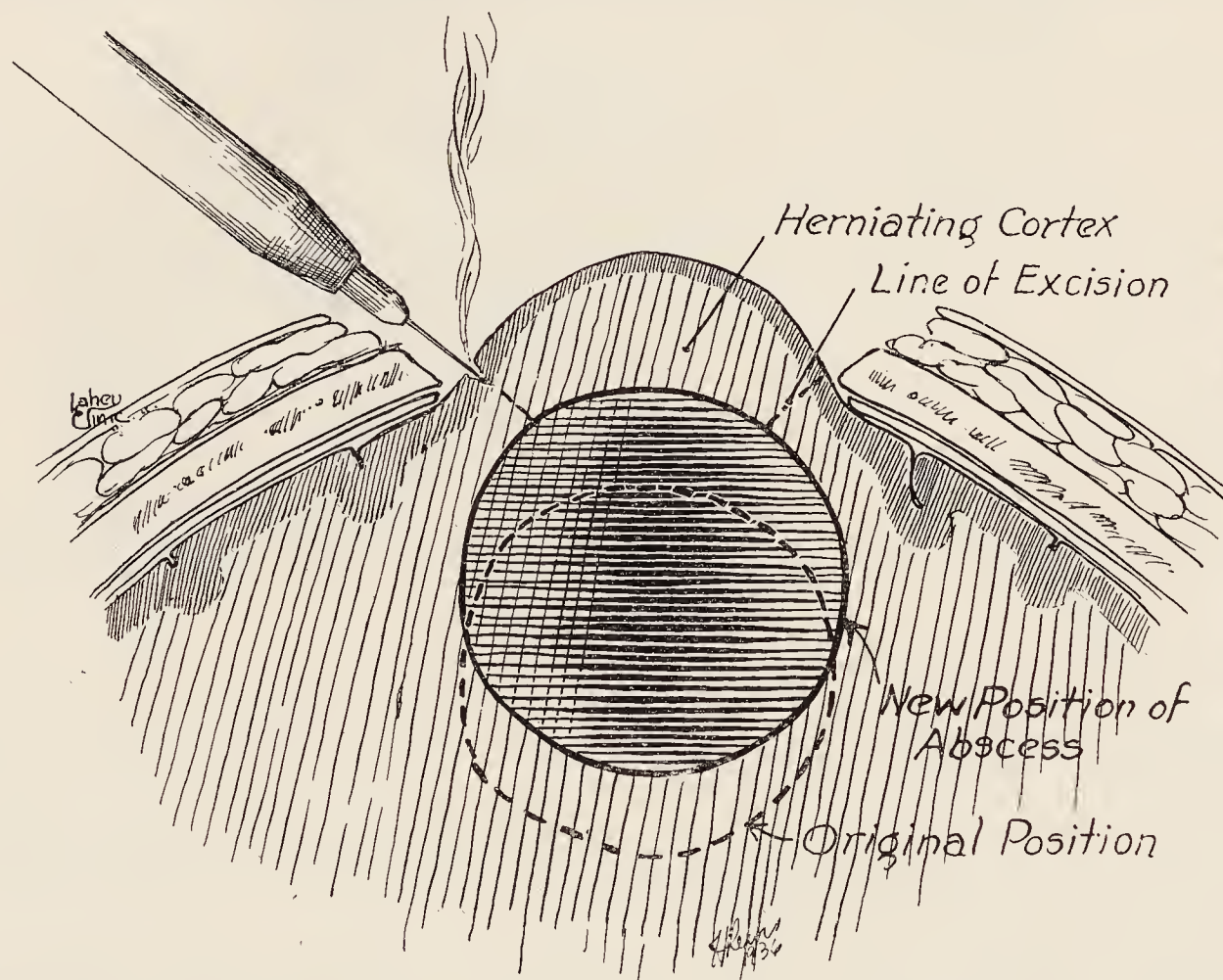


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BRITISH JOUR. OF SURG.

XXV 1938 JAN. PAGE 538

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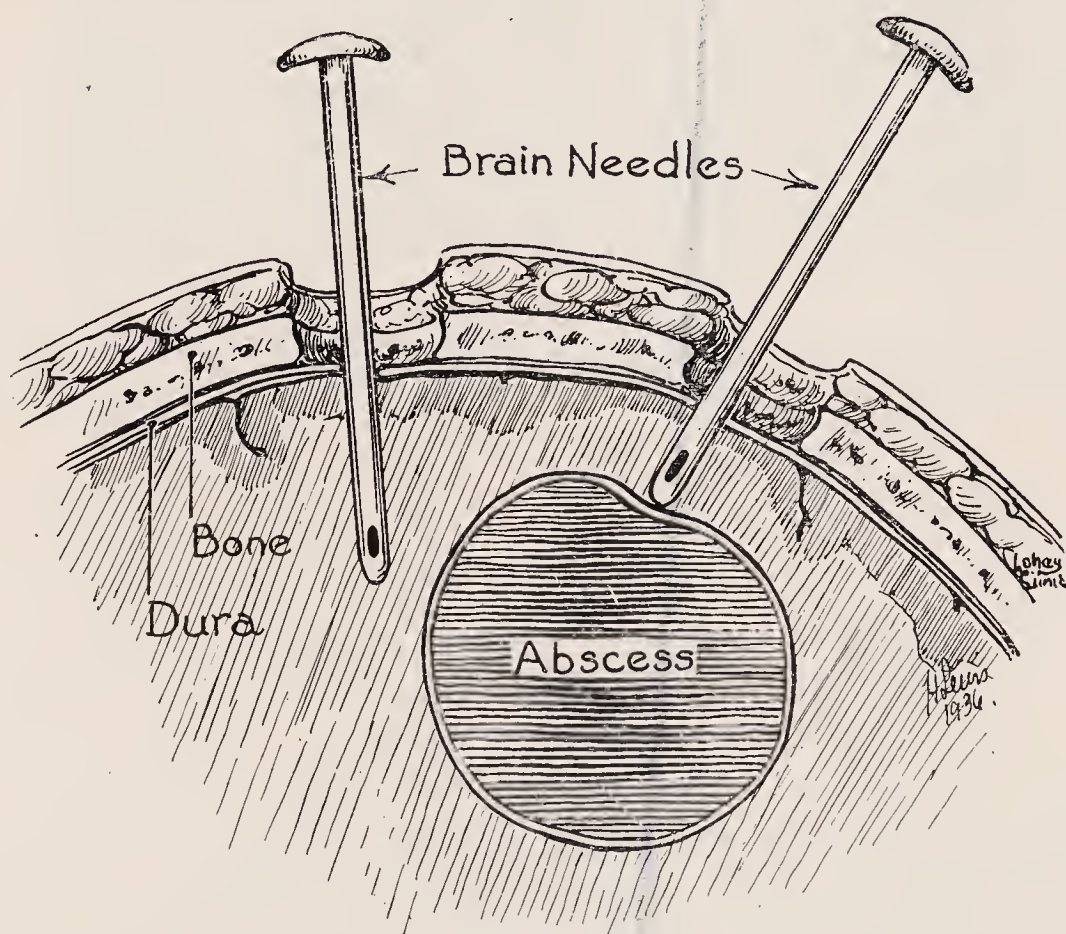


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gross contamination of the surrounding exposed brain and meninges by pent-up pus pouring out over them. This is accomplished by the introduction into the

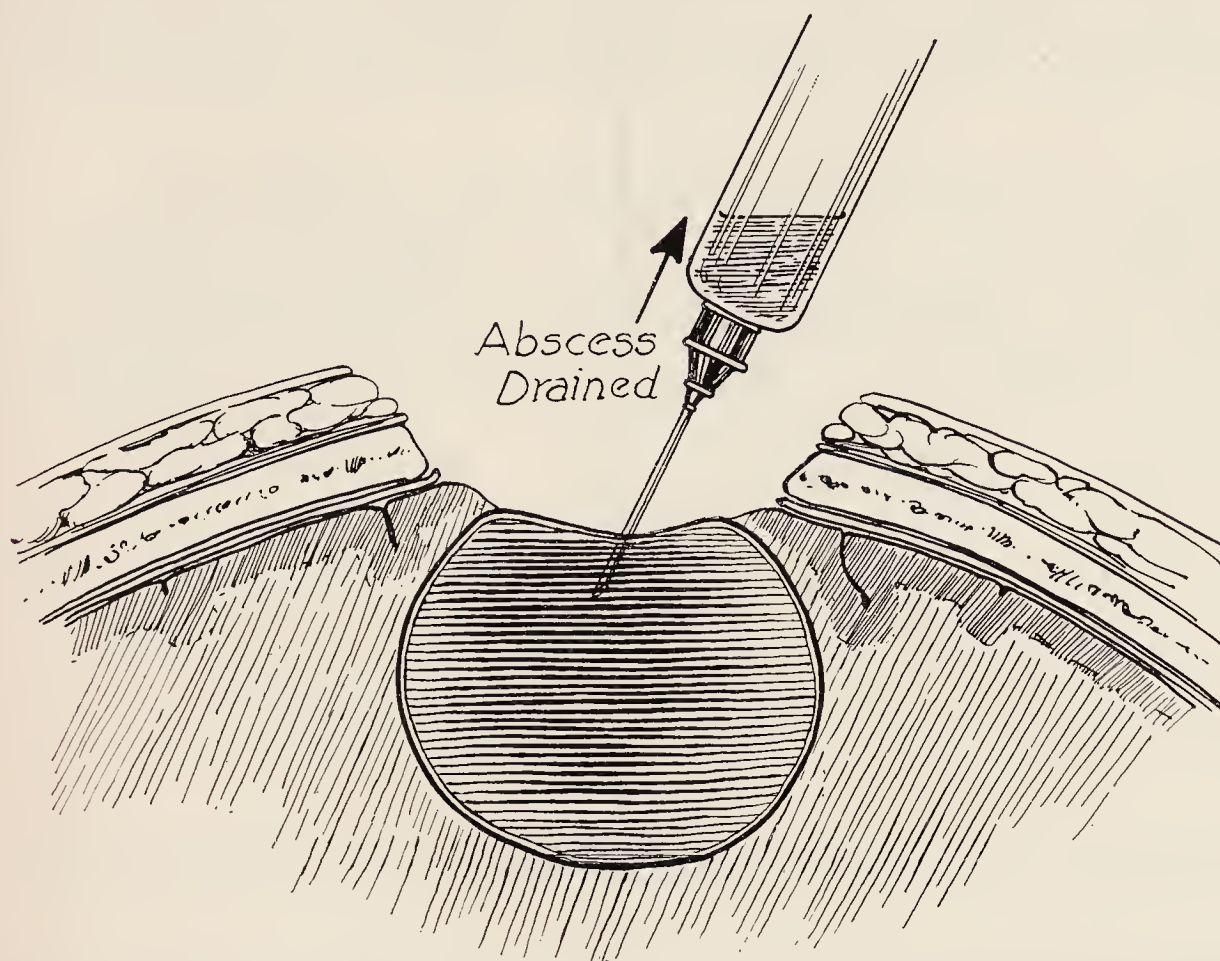


FIG. 385.—Preliminary partial evacuation of the abscess in order to reduce tension and prevent contamination of the surrounding brain when the abscess is opened widely.

abscess of an 18 or 20 gauge needle attached to a syringe and evacuating in this way sufficient pus so that the capsule is collapsed (*Fig. 385*). The needle, still

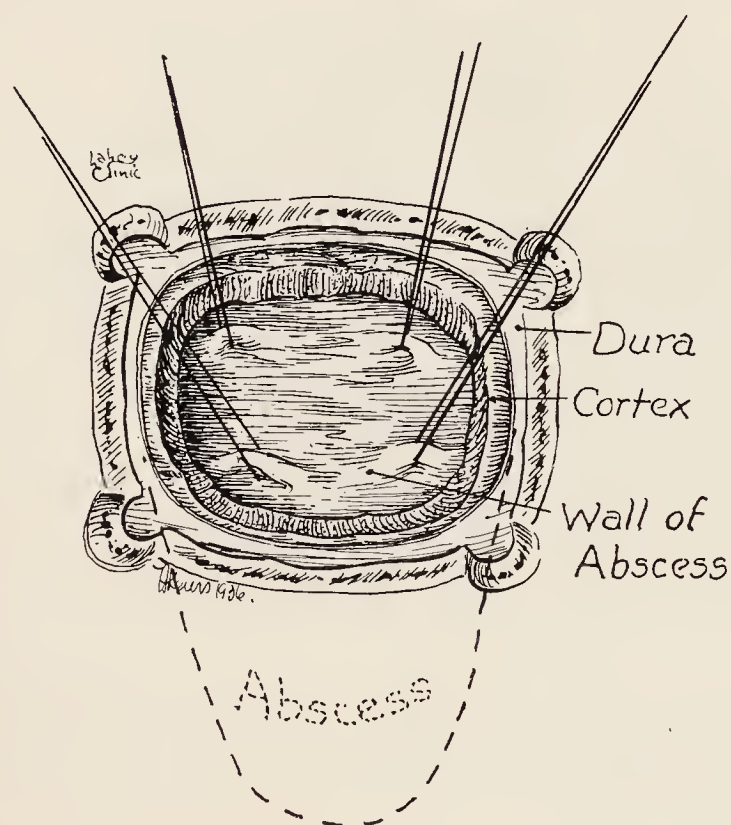


FIG. 386.—Placement of silk stitches in an abscess capsule. The space within the sutures is next opened by wide excision, and the threads then put through the subcutaneous tissues and tied there.

attached to the syringe, is then withdrawn, and the hole left by the needle covered immediately by a small pledget of cotton.

If the abscess capsule is sufficiently thick or firm (and it usually is when the process has been going on from two to four weeks), several stitches of fine silk on fine curved French needles should now be taken through the capsule in the manner and place shown by the illustration (*Fig. 386*). These stitches are held

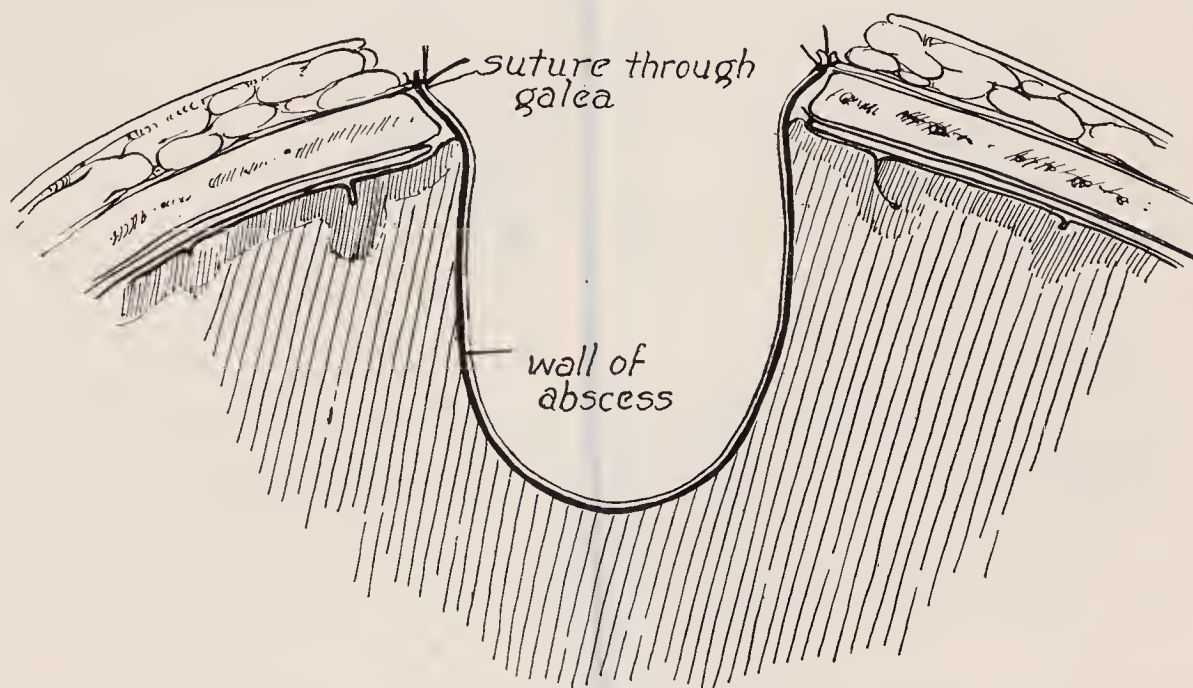


FIG. 387.—Cross-section of abscess showing capsule firmly fixed to the galea by silk sutures which were inserted as in *Fig. 386*. The abscess now becomes a pouch with a wide outside opening.

up by an assistant with just enough tension not to have them tear out. Capsule is then opened widely within the area of these stitches, and the remaining pus evacuated from the cavity by gentle suction. The stitches in the capsule are next

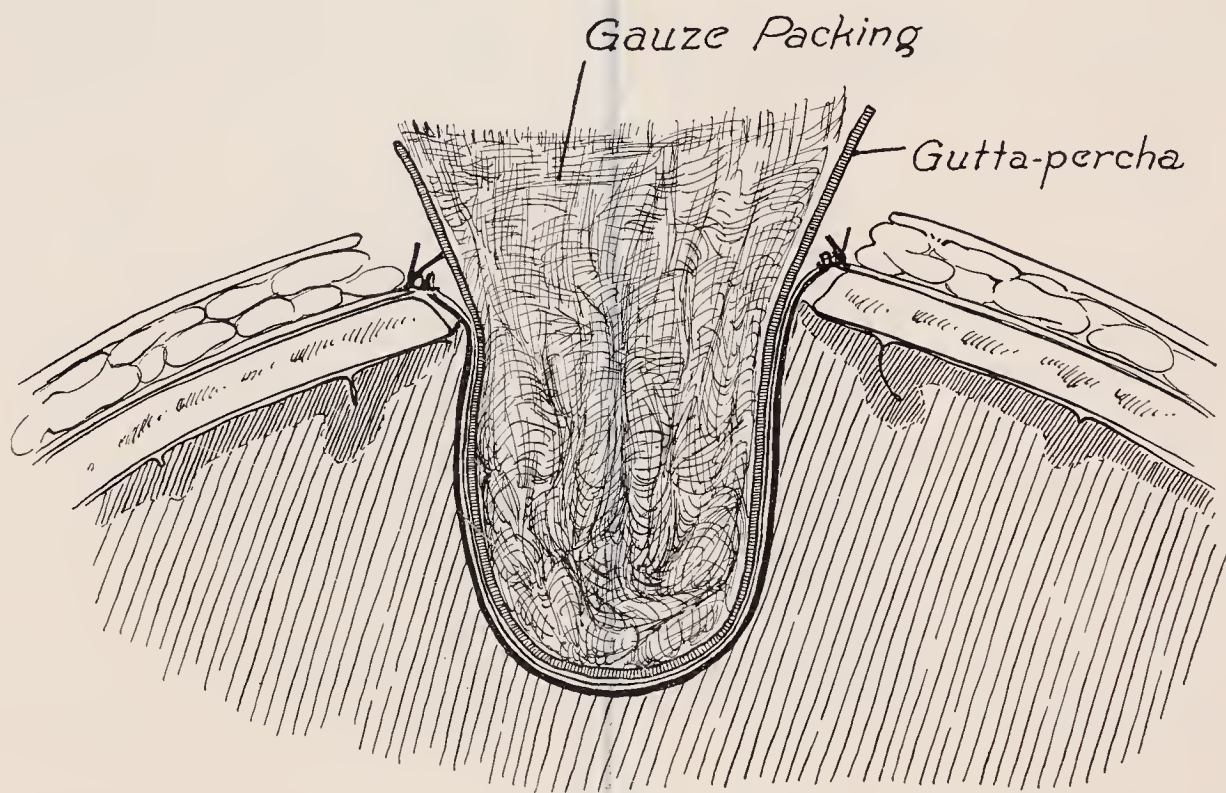


FIG. 388.—The marsupialized abscess held widely open by gauze loosely packed with thin gutta-percha tissue which lies next to the abscess wall. Intracranial pressure gradually pushes this pouch outward until the surface becomes flat and granulates.

sutured to the galea (*Fig. 387*), thus making the mouth of the sac entirely extracranial, and as a final step a fairly large tampon of gauze inside gutta-percha tissue is inserted down to the bottom of the cavity (*Fig. 388*).

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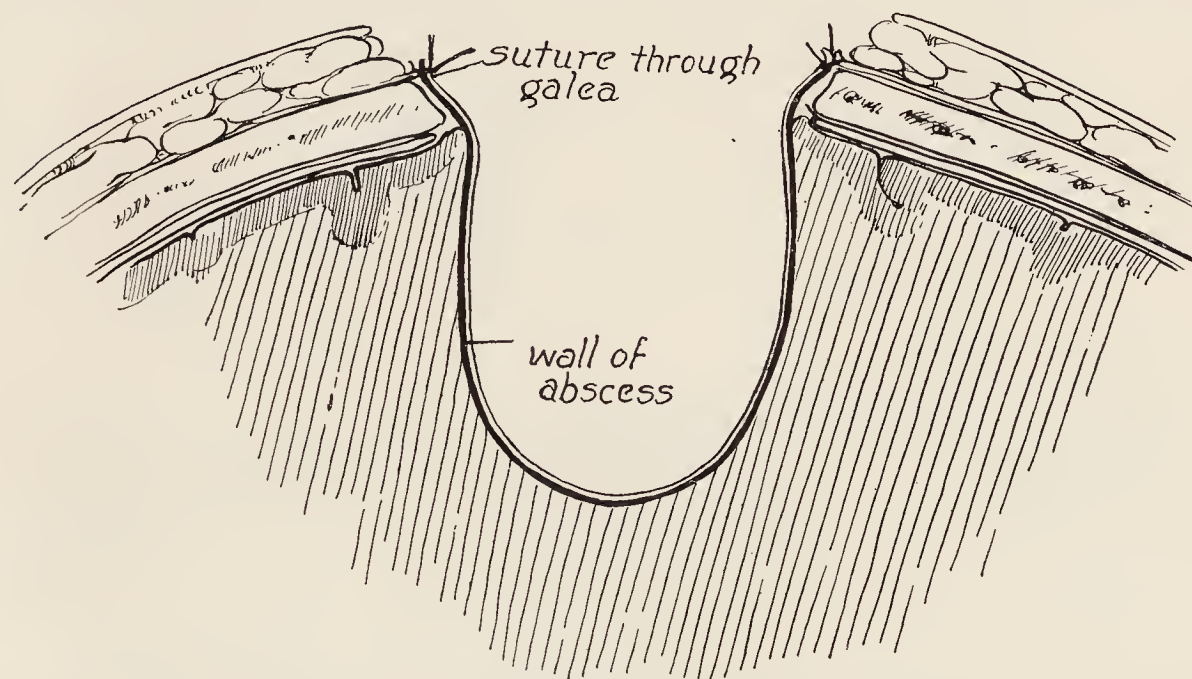


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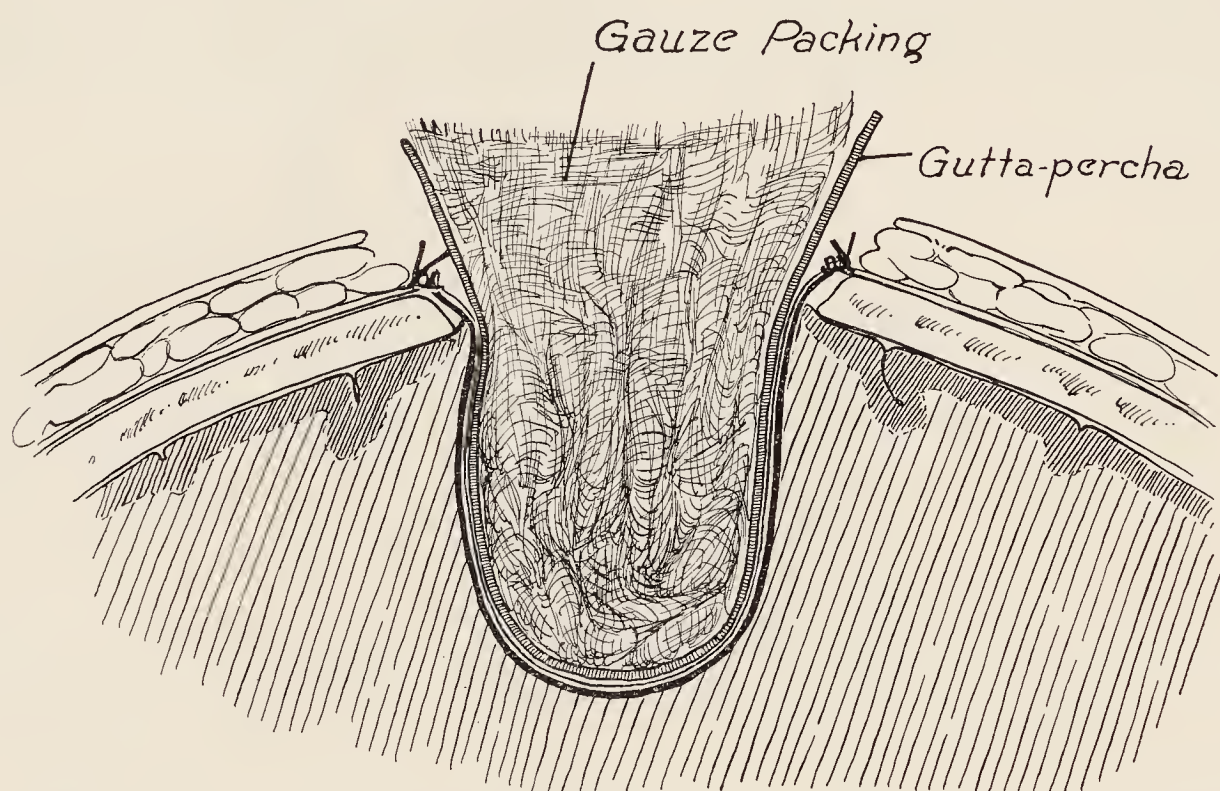


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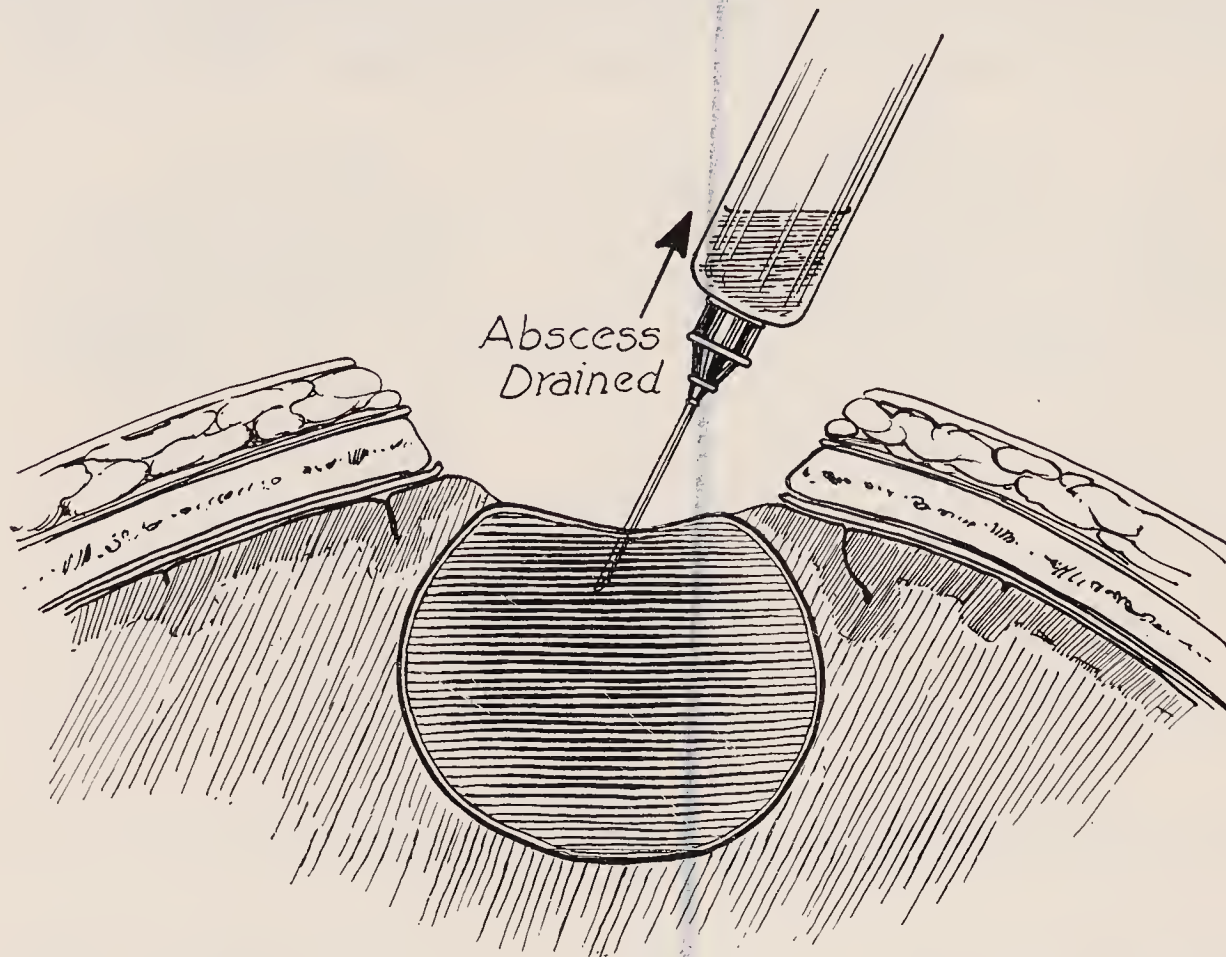


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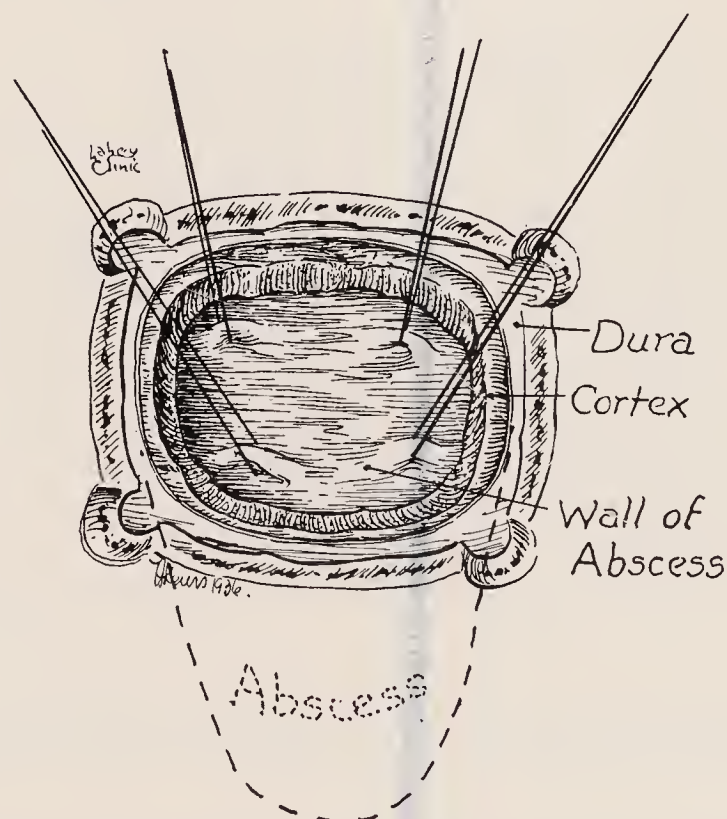


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CASE REPORTS.—The following brief protocols of the nine patients treated by marsupialization give the essential diagnostic, aetiologic, and therapeutic features, together with the end-results.

Case 1.—D. D. (P.B.B.H. Nos. 26177 and 27799), male, aged 7.

AETIOLOGY.—Compound fracture of skull, with subsequent osteomyelitis, in February, 1926. Patient admitted April 17, 1926.

LOCALIZING FEATURES.—Fungus cerebri over right motor area with bony defect by X-ray under fungus. Left hemiparesis. Bilateral choked disks.

TREATMENT.—Abscess under fungus tapped three times and finally drained with catheter. Fungus granulated and healed. Patient discharged July 26, 1926. Returned Jan. 19, 1927, with recurrence of pressure symptoms. Abscess tapped four times, but finally marsupialized March 31, 1927. Cavity contained 70 to 80 c.c. of pus. *Staphylococcus aureus*. Discharged June 4, 1927, well except for some residual weakness of left side.

FOLLOW-UP, April 8, 1929 (2 years after final operation).—General health excellent, attending school, weakness of left arm and slight weakness of left leg.

Case 2.—M. D. (P.B.B.H. No. 28764), female, aged 12. Admitted May 8, 1927.

AETIOLOGY.—Double mastoiditis, Dec. 11, 1926.

LOCALIZING FEATURES.—Jacksonian convulsion five weeks after mastoidectomy Dec. 11, 1926, involving left face and arm. Continuous drainage from left ear. Left hemiparesis and astereognosis. Left lower quadrantal homonymous field defect.

TREATMENT.—Temporo-parietal abscess marsupialized May 13, 1927. Patient discharged July 13, 1927. Some residual weakness of left arm and leg.

FOLLOW-UP, Oct. 31, 1931 (4½ years after operation).—Normal mentally. Some spasticity and weakness of left side. Occasional convulsive seizures for one year.

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AETIOLOGY.—Frontal sinusitis in August, 1926. Operations elsewhere for frontal sinus drainage and drainage of frontal lobe abscess in September, 1926.

LOCALIZING FEATURES.—Return of pressure symptoms and cerebral hernia at old operative site, left frontal region. Bilateral choked disks. Right lower facial weakness.

TREATMENT.—Marsupialization of huge, multilocular abscess of left frontal lobe, May 17, 1927. Cavity contained 100 to 120 c.c. of pus. *Staphylococcus aureus*. Discharged Aug. 7, 1927.

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AETIOLOGY.—Osteomyelitis of skull—left frontal.

LOCALIZING FEATURES.—X-ray evidence of osteomyelitis of left frontal bone. Right-sided Jacksonian convulsions. Bilateral choked disks.

BRITISH JOUR. OF SURG.
XXV 1938 JAN. PAGE 538

TREATMENT.—Excision of osteomyelitic bone. Marsupialization of abscess Dec. 8 and 9, 1927. Large multilocular cavity containing 80 to 100 c.c. of pus. *Staphylococcus hæmolyticus*. Discharged Feb. 20, 1928.

FOLLOW-UP, March 12, 1931 ($3\frac{1}{4}$ years after operation).—Patient in excellent health.

Case 5.—H. A. B. (P.B.B.H. No. 37035), male, aged 35. Admitted Aug. 5, 1930.

AETIOLOGY.—Frontal sinusitis in June, 1930. Removal of right turbinate Aug. 12, 1930.

LOCALIZING FEATURES.—Right frontal sinusitis. Tenderness and swelling over right frontal sinus and of right eyelid. Left lower facial weakness. Mental aberration.

TREATMENT.—Removal of sequestra from frontal bone and marsupialization of right frontal lobe abscess containing 30 c.c. of pus, Aug. 30, 1930. *Staphylococcus aureus*. Death on Sept. 4, 1930.

Case 6.—A. F. F. (P.B.B.H. No. 38566), male, aged 14. Admitted April 7, 1931.

AETIOLOGY.—Furuncle of nose Feb. 15, 1931, with spreading cellulitis of face.

LOCALIZING FEATURES.—Tenderness over left supra-orbital region. Right facial weakness. Right pupil larger than left. Choked disks 3-4 D. Ventriculogram showed left frontal lesion.

TREATMENT.—Left frontal abscess marsupialized April 8, 1931 : 100 c.c. of pus. *Streptococcus hæmolyticus*. Discharged May 31, 1931.

FOLLOW-UP, March 21, 1935 (4 years after operation).—Patient living normal life ; athletic, up to usual grade in school.

Case 7.—A. M. M. (P.B.B.H. No. 37943), female, aged 12. Admitted Jan. 2, 1931.

AETIOLOGY.—Otitis media and mastoiditis three months before admission.

LOCALIZING FEATURES.—Draining left mastoid wound. Right upper quadrantal homonymous field defect. Choked disks 5D. Right lower facial weakness.

TREATMENT.—First operation, Feb. 2, 1931 : abscess tapped. Second operation, eight days later, Feb. 10, 1931 : abscess marsupialized as patient did not improve. *Staphylococcus aureus*. Discharged March 29, 1931.

FOLLOW-UP, Dec. 12, 1931 (10 months post-operative).—Patient in excellent condition.

Case 8.—M. P., female, aged 10. Admitted to N. E. Baptist Hospital, Sept. 25, 1933.

AETIOLOGY.—Abscess of nasal septum, Sept. 1, 1933.

LOCALIZING FEATURES.—None. Ventriculogram showed situation of abscess in left frontal lobe.

TREATMENT.—Marsupialization of abscess Sept. 29, 1933. Large cavity containing 60 to 70 c.c. of pus. *Staphylococcus aureus*. Discharged, Oct. 31, 1933.

FOLLOW-UP, September, 1934 (1 year post-operative).—In excellent condition : attending school.

Case 9.—A. S. (L.C. No. 39957), female, aged 5. Admitted to N. E. Deaconess Hospital, May 4, 1934.

AETIOLOGY.—Not certain, probably upper respiratory infection.

LOCALIZING FEATURES.—Jacksonian convulsions involving left face. Paresis of left arm, face, and leg. Choked disks 1D.

TREATMENT.—Right osteoplastic craniotomy on May 17, 1934, as lesion was thought to be tumour. Encapsulated right frontal lobe abscess encountered. Marsupialization of abscess, containing 80 to 100 c.c. of pus. Organism probably *Staphylococcus aureus*, but culture showed only diphtheroids. Discharged July 14, 1934.

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As observed previously, only two procedures aside from marsupialization need be mentioned in the treatment of chronic encapsulated brain abscesses. These are : (1) Tapping—single or repeated punctures of the abscess with evacuation of the pus by this means ; and (2) Extirpation of the abscess *en bloc*.

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AETIOLOGY.—Osteomyelitis of skull—left frontal.

LOCALIZING FEATURES.—X-ray evidence of osteomyelitis of left frontal bone. Right-sided Jacksonian convulsions. Bilateral choked disks.

Tapping.—Four of the cases in this series were treated by tapping only, with no deaths ; but as will be seen subsequently, several others in whom taps had been tried eventually needed more radical treatment. Three of these patients required repeated tapplings before they were cured, whereas one, a cerebellar abscess, has remained perfectly well for four years after a single evacuation of her abscess by this means. Examination of the pus from all patients in the group which were tapped showed organisms by smear, but no growth could be obtained by culture.



FIG. 389.—Chronic brain abscess with entirely calcified wall, healed successfully by extirpation.

Extirpation.—In three patients complete extirpation of the abscess was carried out successfully, and although there were no deaths by this method it must always be considered a potentially dangerous procedure. Vincent,¹² in an important communication during the present year, called attention to this method preceded by decompression as being particularly applicable in subacute abscesses, and from his description it would appear that it is undoubtedly the ideal way of treating abscesses of this type. The cases in the present series, however, were all of the chronic variety. In one patient at the Children's Hospital, Boston, the abscess wall was entirely calcified, the only example of such a condition in my experience (*Fig. 389*). The lesion was believed to be a tumour before operation.

DISCUSSION

In *Table II* there is given a summary of the various operative procedures together with the end-results in the 18 patients in whom a single encapsulated abscess was found. Sufficient has been said already regarding the technique as

well as the efficacy of the method of marsupialization. Certain comments, however, should be made concerning simple tapping and radical extirpation of a brain abscess.

Table II.—CHRONIC ENCAPSULATED BRAIN ABSCESSES : METHODS OF TREATMENT AND END-RESULTS IN 18 CASES

| CASE No. | SEX | AGE | METHOD OF TREATMENT | LOCATION | END-RESULTS, WITH TIME SINCE OPERATION | DISABILITY, IF ANY |
|----------------|--------|-----|------------------------|------------------|--|---|
| 1. D. D. | Male | 7 | Marsupialization | Right motor area | Improved, 2 yr. | Some weakness of left arm and left leg |
| 2. M. D. | Female | 12 | Marsupialization | Temporo-parietal | Improved, 4½ yr. | Some weakness of left side. Convulsions, 1 yr. |
| 3. L. H. | Female | 15 | Marsupialization | Left frontal | Improved, 9 yr. | Convulsions |
| 4. R. H. | Male | 10 | Marsupialization | Left frontal | Well, 3¼ yr. | None |
| 5. H. A. B. | Male | 35 | Marsupialization | Right frontal | Died | |
| 6. A. F. F. | Male | 14 | Marsupialization | Left frontal | Well, 4 yr. | None |
| 7. A. M. M. | Female | 12 | Marsupialization | Left temporal | Well, 10 mth. | None |
| 8. M. P. | Female | 10 | Marsupialization | Left frontal | Well, 1 yr. | None |
| 9. A. S. | Female | 5 | Marsupialization | Right frontal | Well, 1 yr. | Very slight weakness of left arm |
| 10. G. E. K. | Male | 6 | Repeated tapping | Left frontal | Well, 2 yr. | Some reduction of vision from secondary optic atrophy |
| 11. J. A. | Male | 40 | Repeated tapping | Right parietal | Well, 1 yr. | None |
| 12. B. O. | Male | 10 | Repeated tapping | Left frontal | Well, 1 yr. 10 mth. | None |
| 13. P. R. | Female | 14 | Single tap | Left cerebellar | Well, 3 yr. | None |
| 14. M. M. W. | Male | 28 | Extirpation | Left frontal | Well, 2 yr. 3 mth. | None |
| 15. J. T. C. | Male | 26 | Extirpation | Right temporal | Well, 5 mth. | Died from other cause |
| 16. F. J. | Male | 4 | Extirpation | Right parietal | Well, 5 yr. | None |
| 17. T. J. O'D. | Male | 50 | Rubber tissue drainage | Right temporal | Died | |
| 18. E. R. P. | Male | 17 | Negative cerebral tap | Left frontal | Died | |

From a glance at the table it will be noted that all four patients who were treated only by single or repeated tapplings recovered and were well from one to three years subsequently. This does not tell the whole story, however, since three of the patients who eventually came to marsupialization received one or more taps, and did so badly by this method that there is no doubt they would have died unless the more radical procedure had been carried out. In this case the mortality from tapping only would have been 43 per cent instead of zero. On the other hand, I am inclined to agree in certain particulars with Dandy, who has so forcefully advocated this method, when he says that in general one should do as little as seems necessary in the presence of a single encapsulated abscess. It is possible that tapping should always be tried first, but I feel that it is potentially dangerous for two reasons. In the first place, other foci of infection may be started along the track of the needle as it is withdrawn; and in the second place, even after an abscess has been tapped it may refill so rapidly as to cause sudden increased intracranial pressure and even death before proper measures can be instituted. Furthermore, King¹³ (1936) included a significant statement in an excellent article dealing with the subject in hand. He says: "Recently I saw sections of three brains

well as the efficacy of the method of marsupialization. Certain comments, however, should be made concerning simple tapping and radical extirpation of a brain abscess.

Table II.—CHRONIC ENCAPSULATED BRAIN ABSCESSES : METHODS OF TREATMENT AND END-RESULTS IN 18 CASES

| CASE No. | SEX | AGE | METHOD OF TREATMENT | LOCATION | END-RESULTS, WITH TIME SINCE OPERATION | DISABILITY, IF ANY |
|----------------|--------|-----|------------------------|------------------|--|---|
| 1. D. D. | Male | 7 | Marsupialization | Right motor area | Improved, 2 yr. | Some weakness of left arm and left leg |
| 2. M. D. | Female | 12 | Marsupialization | Temporo-parietal | Improved, 4½ yr. | Some weakness of left side. Convulsions, 1 yr. |
| 3. L. H. | Female | 15 | Marsupialization | Left frontal | Improved, 9 yr. | Convulsions |
| 4. R. H. | Male | 10 | Marsupialization | Left frontal | Well, 3¼ yr. | None |
| 5. H. A. B. | Male | 35 | Marsupialization | Right frontal | Died | |
| 6. A. F. F. | Male | 14 | Marsupialization | Left frontal | Well, 4 yr. | None |
| 7. A. M. M. | Female | 12 | Marsupialization | Left temporal | Well, 10 mth. | None |
| 8. M. P. | Female | 10 | Marsupialization | Left frontal | Well, 1 yr. | None |
| 9. A. S. | Female | 5 | Marsupialization | Right frontal | Well, 1 yr. | Very slight weakness of left arm |
| 10. G. E. K. | Male | 6 | Repeated tapping | Left frontal | Well, 2 yr. | Some reduction in vision from secondary optic atrophy |
| 11. J. A. | Male | 40 | Repeated tapping | Right parietal | Well, 1 yr. | None |
| 12. B. O. | Male | 10 | Repeated tapping | Left frontal | Well, 1 yr. 10 mth. | None |
| 13. P. R. | Female | 14 | Single tap | Left cerebellar | Well, 3 yr. | None |
| 14. M. M. W. | Male | 28 | Extirpation | Left frontal | Well, 2 yr. 3 mth. | None |
| 15. J. T. C. | Male | 26 | Extirpation | Right temporal | Well, 5 mth. | Died from other cause |
| 16. F. J. | Male | 4 | Extirpation | Right parietal | Well, 5 yr. | None |
| 17. T. J. O'D. | Male | 50 | Rubber tissue drainage | Right temporal | Died | |
| 18. E. R. P. | Male | 17 | Negative cerebral tap | Left frontal | Died | |

From a glance at the table it will be noted that all four patients who were treated only by single or repeated tapplings recovered and were well from one to three years subsequently. This does not tell the whole story, however, since three of the patients who eventually came to marsupialization received one or more taps, and did so fully by this method that there is no doubt they would have died unless the more radical procedure had been carried out. In this case the mortality from tapping only would have been 43 per cent instead of zero. On the other hand, I am inclined to agree in certain particulars with Dandy, who has so forcefully advocated this method, when he says that in general one should do as little as seems necessary in the presence of a single encapsulated abscess. It is possible that tapping should always be tried first, but I feel that it is potentially dangerous for two reasons. In the first place, other foci of infection may be started along the track of the needle as it is withdrawn; and in the second place, even after an abscess has been tapped it may refill so rapidly as to cause sudden increased intracranial pressure and even death before proper measures can be instituted. Furthermore, King¹³ (1936) included a significant statement in an excellent article dealing with the subject in hand. He says: "Recently I saw sections of three brains

BRITISH JOUR. OF SURG.
X X V 1938 JAN. PAGE 538

Tapping.—Four of the cases in this series were treated by tapping only, with no deaths ; but as will be seen subsequently, several others in whom taps had been tried eventually needed more radical treatment. Three of these patients required repeated tappings before they were cured, whereas one, a cerebellar abscess, has remained perfectly well for four years after a single evacuation of her abscess by this means. Examination of the pus from all patients in the group which were tapped showed organisms by smear, but no growth could be obtained by culture.



FIG. 389.—Chronic brain abscess with entirely calcified wall, healed successfully by extirpation.

Extirpation.—In three patients complete extirpation of the abscess was carried out successfully, and although there were no deaths by this method it must always be considered a potentially dangerous procedure. Vincent,¹² in an important communication during the present year, called attention to this method preceded by decompression as being particularly applicable in subacute abscesses, and from his description it would appear that it is undoubtedly the ideal way of treating abscesses of this type. The cases in the present series, however, were all of the chronic variety. In one patient at the Children's Hospital, Boston, the abscess wall was entirely calcified, the only example of such a condition in my experience (*Fig. 389*). The lesion was believed to be a tumour before operation.

DISCUSSION

In *Table II* there is given a summary of the various operative procedures together with the end-results in the 18 patients in whom a single encapsulated abscess was found. Sufficient has been said already regarding the technique as

which had been removed from patients who had been operated upon consecutively by one of my colleagues according to this method [tapping]. He told me of the autopsy findings in a fourth case. He has given up the use of this type of operation." Cairns¹⁰ likewise says of tapping: "We have not found this satisfactory". On the other hand, Vincent makes use of repeated taps while waiting for abscesses to encapsulate more thoroughly, but it is intimated that further treatment is usually necessary. Grant, in discussing a paper by Kahn,¹⁴ reports the recovery of 5 out of 7 cases from tapping, but this is a mortality of 28 per cent, which is nearly three times greater than the rate given by Macewen, who used open drainage, and more than twice that of our marsupialized cases.

Vincent and his associates are the most ardent exponents of complete extirpation of well-encapsulated brain abscesses, and their results have been most striking. Puech, Eliades, and Askenasy¹⁵ (1935) reported 8 cases treated by this method, with no deaths from infection, but 2 of the cases died from other causes. My own experience with actual extirpations has been extremely limited, but if it can be accomplished successfully, without drainage, there is no doubt that much time can be saved in hospitalization, for the patient. In the 3 patients of our series drainage was instituted, and, although they all recovered, their course in hospital was as long as the patients treated by marsupialization.

CONCLUSIONS

1. The study of a series of 30 brain abscesses covering a period of nine years is presented.

2. The series is divided into two distinct groups, which differ radically from each other both as to their clinical course and classification, their operability, and their prognosis.

3. In the first group—acute and multiple, often metastatic abscesses, usually having severe systemic or pulmonary complications—the outcome is probably always hopeless.

4. In the second group—chronic single, usually encapsulated, abscesses—the prognosis should be favourable, with a mortality not exceeding 10 to 20 per cent, instead of the generally accepted death-rate of 30 to 40 per cent.

5. A discussion of present-day operative methods employed in the treatment of brain abscesses is given, together with certain details of the technique known as 'marsupialization', which is here regarded as the treatment of choice.

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